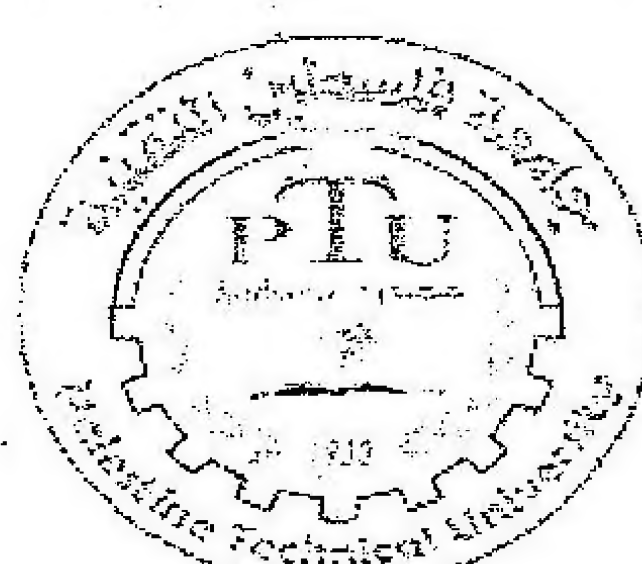


اصول مدارات دال على :- سعة الاتصالات (2-1)

انتم الرفع بواسطة م. من ابو عيسى

Circuit 1
First

Specialization:	Engineering (General)		<p>Palestinian National Authority Ministry Education & Higher Education Palestine Technical University College of Engineering & Technology</p> <p>First Exam First semester 2010/2011</p>		
Course Name:	Electric Circuits Electric Circuits 1				
Date:	18/10/2010				
Time:	11:00-12:00				
Instructor:	م. محمود دلاجر				
Name:	معن سلام قحطان	Section:	2-1	Mark:	21 / 25

Please answer **all** the following 5 questions

Q1. (7 marks) Using mesh analysis, find the power of the 12 volts source

$$i_1 = 4A$$

Mesh ②

$$2(i_2 - i_1) + 0.5V_x + 1(i_2 - i_4) = 0$$

$$2(i_2 - 4) + 0.5V_x + 1(i_2 - i_4) = 0$$

$$2i_2 - 8 + i_2 - i_4 + 0.5V_x = 0$$

$$3i_2 - i_4 + 0.5V_x = 8$$

$$2(i_2 - 4) + 0.5(2(i_3 - 4)) + i_2 - i_4 = 0$$

$$2i_2 - 8 + i_3 - 4 + i_2 - i_4 = 0$$

$$3i_2 + i_3 - i_4 - 12 = 0 \Rightarrow 3i_2 + i_3 - i_4 = 12 \quad (1)$$

Mesh ④ :- $1(i_4 - i_2) + 12 + 1(i_4 - i_3) = 0$

$$i_4 - i_2 + 12 + i_4 - i_3 = 0$$

$$-i_2 - i_3 + 2i_4 = -12 \quad (2)$$

Mesh ③ :- $2(i_3 - 4) + 1(i_3 - i_4) - I_x = 0$

$$2(i_3 - 4) + 1(i_3 - i_4) - (i_4 - i_2) = 0$$

$$2i_3 - 8 + i_3 - i_4 - i_4 + i_2 = 0$$

$$i_2 + 3i_3 - 2i_4 = 8 \quad (3)$$

$$\Delta = \begin{vmatrix} 3 & 1 & -1 \\ -1 & -1 & 2 \\ 1 & 3 & -2 \end{vmatrix} = 3 \begin{vmatrix} -1 & 2 \\ 3 & -2 \end{vmatrix} - 1 \begin{vmatrix} -1 & 2 \\ 1 & -2 \end{vmatrix} + 1 \begin{vmatrix} -1 & -1 \\ 1 & 3 \end{vmatrix} = 3(-4) - 0 + 1(-2+3) = -12 + 0 + 1 = -11$$

$$\Delta_2 = \begin{vmatrix} 12 & 1 & -1 \\ -12 & -1 & 2 \\ 8 & 3 & -2 \end{vmatrix} = 12 \begin{vmatrix} -1 & 2 \\ 3 & -2 \end{vmatrix} - 1 \begin{vmatrix} -12 & 2 \\ 8 & -2 \end{vmatrix} + 1 \begin{vmatrix} -12 & -1 \\ 8 & 3 \end{vmatrix} = 12(-4) - 1(-24-16) + 1(-36-8) = -48 + 40 - 44 = -52$$

$$\Delta_3 = \begin{vmatrix} 3 & 12 & -1 \\ -1 & -12 & 2 \\ 1 & 8 & -2 \end{vmatrix} = 3 \begin{vmatrix} -12 & 2 \\ 8 & -2 \end{vmatrix} - 12 \begin{vmatrix} -1 & 2 \\ 1 & -2 \end{vmatrix} + 1 \begin{vmatrix} -1 & -12 \\ 1 & 8 \end{vmatrix} = 3(24-16) - 12(2-2) + 1(-8-12) = 24 - 0 - 20 = 4$$

خلف الصفحة

Q1 & E

$$\Delta 4 = \begin{vmatrix} 3 & 1 & 12 \\ -1 & -1 & -12 \\ 1 & 3 & 8 \end{vmatrix} = 3 \begin{vmatrix} -1 & -12 \\ 3 & 8 \end{vmatrix} - 1 \begin{vmatrix} -1 & -12 \\ 1 & 8 \end{vmatrix} + 12 \begin{vmatrix} -1 & -1 \\ 1 & 3 \end{vmatrix}$$

$$= 3(+28) - 1(4) + 12(-2)$$

$$= +84 - 4 - 24 = \boxed{56}$$

$$\therefore i_1 = \boxed{4A}$$

$$\therefore i_2 = \frac{\Delta 2}{\Delta} = \frac{-28}{-10} = \boxed{2.8A}$$

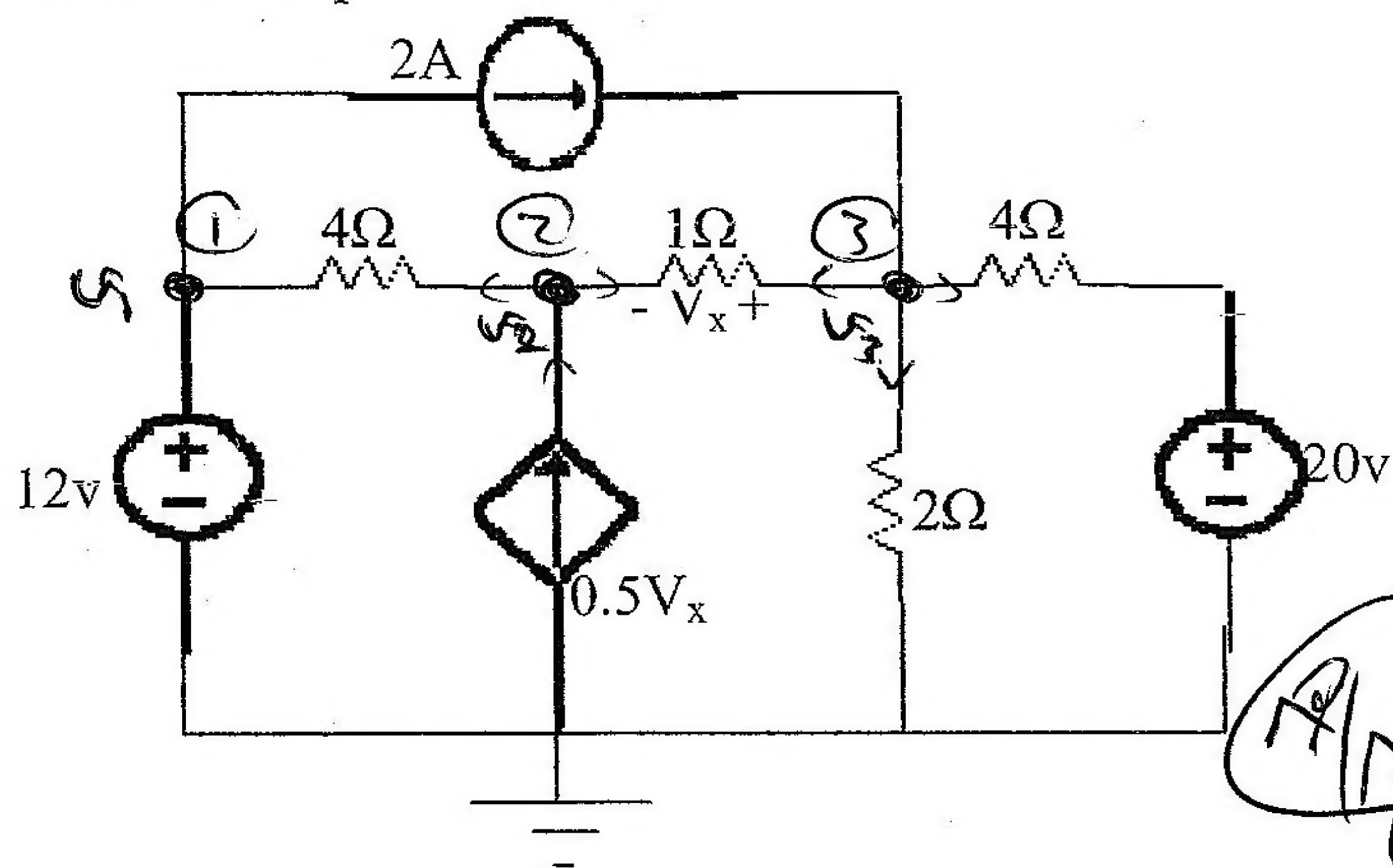
$$\therefore i_3 = \frac{\Delta 3}{\Delta} = \frac{20}{-10} = \boxed{-2A}$$

$$\therefore i_4 = \frac{\Delta 4}{\Delta} = \frac{56}{-10} = \boxed{-5.6A}$$

$$P_{nv} = IV = (-5.6)(12) = \boxed{-67.2 \text{ watt}}$$

generates

Q2. (7 marks) Using nodal analysis, find the power of the dependent source



$$V_1 = 12 \text{ V}$$

Node 2 :-

$$0.5 V_x = \frac{V_2 - V_3}{1} + \frac{V_2 - 12}{4}$$

$$V_x = V_3 - V_2$$

$$0.5 (V_3 - V_2) = \frac{V_2 - V_3}{1} + \frac{V_2 - 12}{4} \quad \times 4$$

$$2 (V_3 - V_2) = 4V_2 - 4V_3 + V_2 - 12$$

$$2V_3 - 2V_2 = 4V_2 - 4V_3 + V_2 - 12$$

$$4V_2 - 4V_3 - 2V_3 + 2V_2 + V_2 = 12$$

$$7V_2 - 6V_3 = 12 \quad \text{--- (1)}$$

Node 3 :-

$$2 = \frac{V_3 - V_2}{1} + \frac{V_3}{2} + \frac{V_3 - 20}{4} \quad \times 4$$

$$8 = 4V_3 - 4V_2 + 2V_3 + V_3 - 20$$

$$20 + 8 = 4V_3 - 4V_2 + 2V_3 + V_3$$

$$7V_3 - 4V_2 = 28 \quad \text{--- (2)}$$

$$-4V_2 + 7V_3 = 28$$

$$\Delta = \begin{vmatrix} 7 & -6 \\ -4 & 7 \end{vmatrix} = 49 - (-24) = 25$$

$$\Delta_2 = \begin{vmatrix} 12 & -6 \\ 28 & 7 \end{vmatrix} = 84 - (-168) = 84 + 168 = 252$$

$$\Delta_3 = \begin{vmatrix} 7 & 12 \\ -4 & 28 \end{vmatrix} = 196 - (-48) = 244$$

$$\therefore V_2 = \frac{\Delta_2}{\Delta} = \frac{252}{25} = 10.08 \text{ V}$$

$$\therefore V_3 = \frac{\Delta_3}{\Delta} = \frac{244}{25} = 9.76 \text{ V}$$

القدرة

$$Q_2 \text{ 2.5}$$

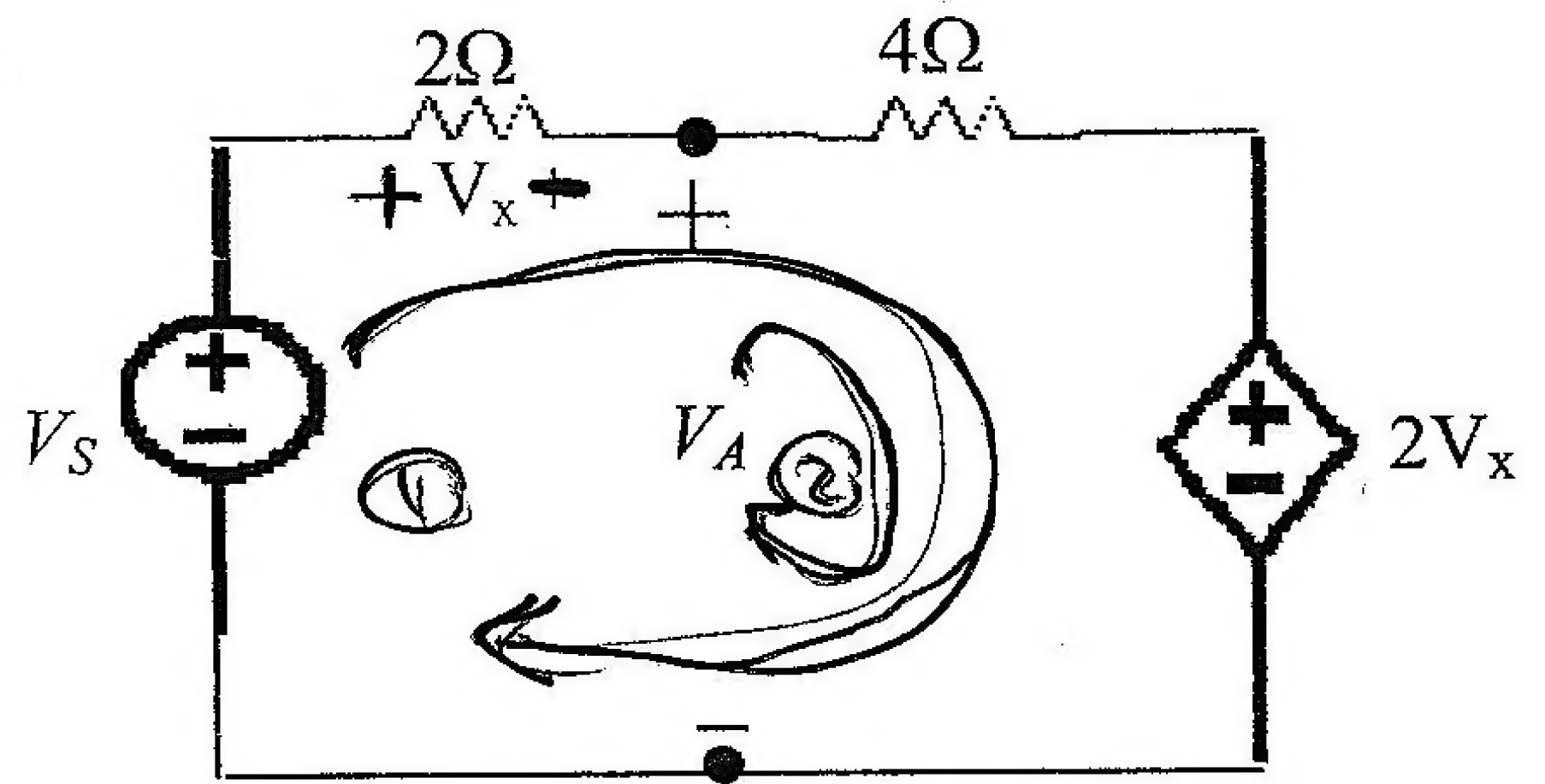
$$V_x = V_3 - V_2 = 9.76 - 10.08 = \boxed{-0.32 \text{ V}}$$

$$\text{dependent Source} = 0.5 V_x = 0.5 (-0.32) = \boxed{-0.16 \text{ A}}$$

$$P_{0.5 V_x} = I V_2 = (-0.16)(10.08) = \cancel{1.6128} = \boxed{-1.6128 \text{ watt}}$$

generates

Q3. (3 marks) In the circuit shown below, if $V_A = 12\text{volt}$, find V_S



Loop ① cc-

$$-V_S + 2i_1 + 4i_1 + 2V_x = 0$$

$$V_x = 2i_1$$

$$\therefore -V_S + 2i_1 + 4i_1 + 2(2i_1) = 0$$

$$-V_S + 2i_1 + 4i_1 + 4i_1 = 0$$

$$-V_S + 10i_1 = 0$$

Loop ② cc-

$$V_A + 4i_1 + 2V_x = 0$$

$$12 + 4i_1 + 2(2i_1) = 0$$

$$12 + 4i_1 + 4i_1 = 0$$

$$12 + 8i_1 = 0 \Rightarrow i_1 = \frac{-12}{8} = \boxed{-1.5\text{A}}$$

$$\therefore -V_S + 10i_1 = 0$$

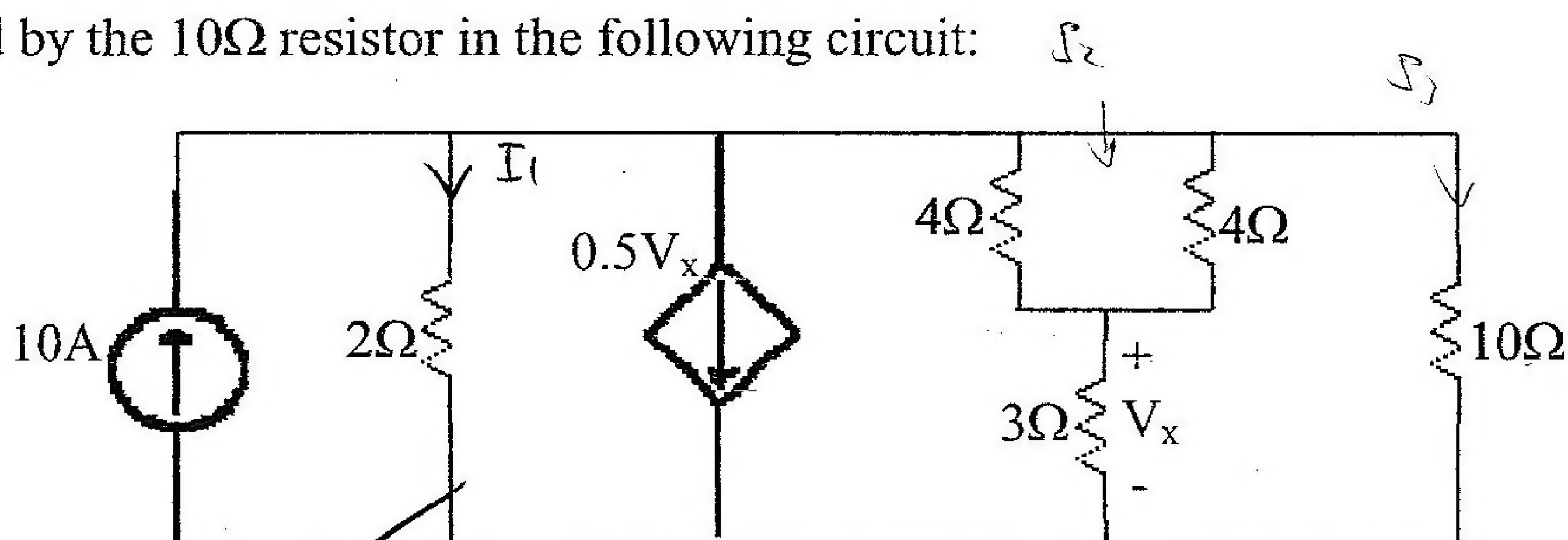
$$-V_S + 10(-1.5) = 0$$

$$-V_S - 15 = 0$$

$$\boxed{V_S = -15\text{V}}$$

3/3

Q4. (4 marks) Find the power absorbed by the 10Ω resistor in the following circuit:



$$4 \parallel 4 = \frac{4 \times 4}{4 + 4} = \frac{16}{8} = 2\Omega$$

$$10 = I_1 + 0.5V_x + I_2 + I_3$$

$$10 = \frac{V}{2} + 0.5V_x + \frac{V}{3} + \frac{V}{10}$$

$$V_x = 3I_2 = 3\left(\frac{V}{3}\right) = \frac{3}{5}V$$

~~$$10 = \frac{V}{2} + \frac{3}{5}V + \frac{V}{3} + \frac{V}{10}$$~~

$$\therefore 0.5V_x = \frac{1}{2}\left(\frac{3}{5}V\right) = \frac{3}{10}V$$

~~$$10 = \frac{V}{2} + \frac{3}{10}V + \frac{V}{3} + \frac{V}{10} \times 10$$~~

$$100 = 5V + 3V + 2V + V$$

~~$$100 = 11V \Rightarrow V = \frac{100}{11} = 9.09 \text{ Volts}$$~~

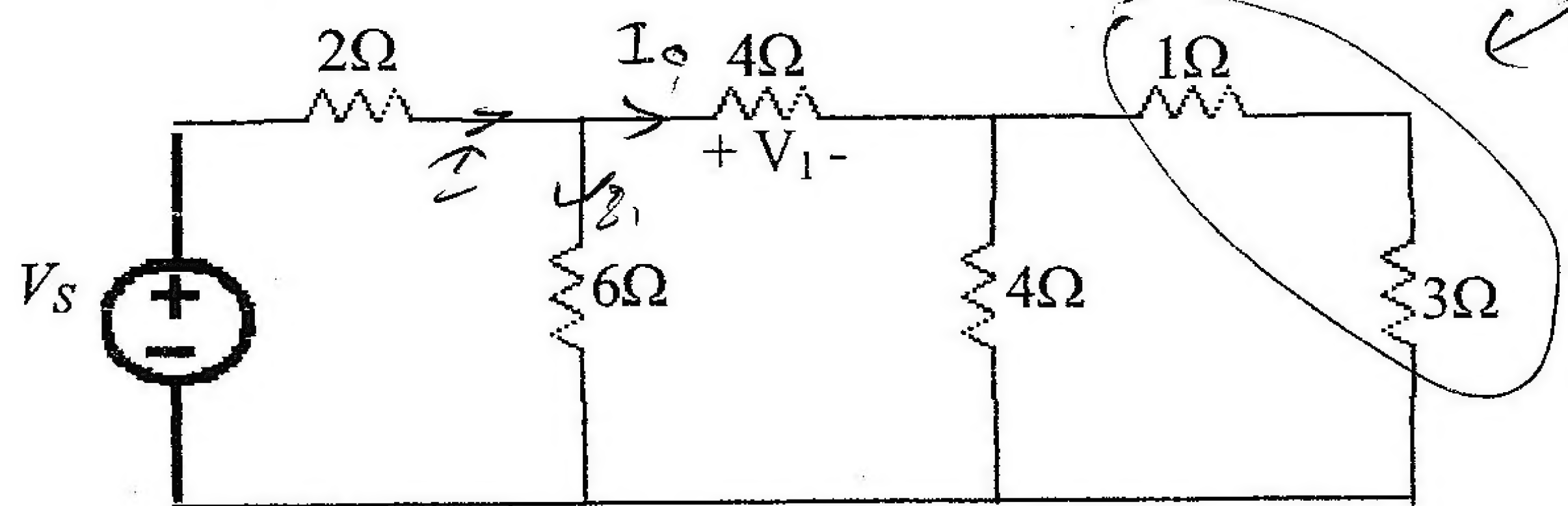
$$100 = 11V \Rightarrow V = \frac{100}{11} = 9.09 \text{ Volts}$$

$$\textcircled{*} P_{10\Omega} = \frac{V^2}{R} = \frac{(9.09)^2}{10} = 8.26 \text{ Watt}$$

$$\textcircled{*} V_x = \frac{3}{10}V = \frac{3}{10}(9.09) = 2.72 \text{ Volts}$$

absorbs

Q5. (4 marks) In the circuit shown below if $V_1 = 12\text{volt}$, find V_S and the power of 3Ω resistor



$$V_1 = 12\text{V}$$

$$\therefore I_0 = \frac{12}{4} = 3\text{A}$$

$$1+3 \text{ (Series)} = 4\Omega$$

$$4 \parallel 4 = \frac{4 \times 4}{4+4} = \frac{16}{8} = 2\Omega$$

$$2+4 \text{ (series)} = 6\Omega$$

$$I_0 = 3\text{A}$$

$$3 = I_1 \left(\frac{6}{6+6} \right)$$

$$3 = \frac{6}{12} I_1$$

$$\therefore 3 = 0.5 I_1 \Rightarrow I_1 = 6\text{A}$$

$$6 \parallel 6 = \frac{6 \times 6}{6+6} = \frac{36}{12} = 3\Omega$$

$$(3+2) \text{ series} = 5\Omega$$

$$\therefore V_S = (6\text{A})(5\Omega) = 30\text{V}$$

Look to Fig 1

$$I_2 = 3 \left(\frac{4}{4+4} \right) = 3 \left(\frac{4}{8} \right) = 1.5\text{A}$$

\therefore Current in 1Ω and 3Ω is 1.5A

$$\therefore P_{3\Omega} = I^2 R = (1.5)^2 (3) = 6.75\text{ watt}$$

absorbs

